# Testing, Analysis, and Conservation of a 1566 Tyndale Bible

A Senior Honors Thesis

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## Abstract

The subject of this research project is an English Tyndale Bible circa 1566 that was owned by a prominent family in Cornwall, England for many years and now resides in the Rare Books Collection at The Ohio State University. This Bible is unique in that all of its pages are covered in a yellow coating that was deliberately placed sometime before the book was rebound around the late 18th century. When the Bible was rebound, pages were added to accommodate the family history of the Bond family of East Looe. A facsimile copy of the title page was also added and painted yellow with watercolor to imitate the rest of the Bible. Each yellow page of the Bible varies in coloring with the amount of coating on the page and individual brushstrokes can be seen on certain leaves. The coloring of the pages ranges from yellow to brown. When the Bible was rebound several corners and edges remained folded in and untrimmed. On these fragments it can be observed that the edges were gilded at some point prior to rebinding. This version of the Bible was printed by Richard Jugge in London in 1566. Six years after Elizabeth I came to the throne, in 1564, she assigned the privilege of printing all Bibles to Richard Jugge.[1]

This research project focuses on answering the questions of what the "paint" is, why it was put there, who put it there, and what is the best way to conserve such a rare document. The research conducted on the Bible includes analysis by scanning electron microscopy (SEM), energy dispersive spectrometry (EDS), Raman spectroscopy, UV-Vis Diffuse Reflectance with a Barium Sulfate reference, Attenuated Total Reflectance-Fourier Transform Infrared (ATR-FTIR) Spectroscopy, Emission Spectroscopy, pH testing, and the simple application of UV light to the sample. Some non-analytic testing has also been done on plain paper from the same period as the Bible paper including the application of beeswax and turpentine. This testing showed that the yellow coating is most likely a beeswax and turpentine with a yellow pigment such as saffron or yellow ochre. The reason behind the color is still unknown although theories such as a way to disguise the Bible, preservation, and an attempt to make the Bible look more expensive are considered. Other Bibles and books from this period do exist with a similar yellow coating but none have been studied. This research project is important to the field of paper conservation because the coating on the pages is so unusual and has not been subjected to extensive study before this time. Analyzing why the "paint" was applied could reveal important information concerning how people of the 16th, 17th and 18th centuries treated their important literature.

History and Archival Research

1. **A concise history of William Tyndale and the Bible in English**

In England, the country of William Tyndale, the Bible played an important part in history from at least the fourth century A.D. on. Jerome made the Latin Vulgate, which was greatly admired and studied by the English. Outside of preaching, the early common people learned Bible stories through murals and paintings on church walls.[2] Poems were also sung and handed down orally until the first Psalter was translated into Old English around 700 A.D.[3] After the Norman Conquest of 1066 the English language and writing suffered under the influence of William the Conqueror.[4] The Wycliffe Bible was the first full Bible translated into English although John Wycliffe may have had nothing to do with the actual translation.[5] Wycliffe and his colleagues based their first translation, which appeared around 1380, on the Latin Vulgate[6] while the second version was written in 1396, after Wycliffe's death, and based on several more Latin sources.[7] In the mid-fifteenth century Johann Gutenberg invented the printing press and printing became a way to spread religious doctrine throughout the known world. William Tyndale's Bible was the first to be printed in English.[8]

William Tyndale was one of the most important contributors to translating the Bible to English. He created phrases that are still common in the English language today even though relatively little is known of his early life.[9] Tyndale is thought to have been born in Gloucestershire around 1494.[10] The first record of Tyndale is his graduation with a BA from Oxford University in 1512 and an MA in 1515.[11] Tyndale's next move was probably to Cambridge where Martin Luther's version of the Bible was discussed readily.[12] Tyndale

then returned to his home in Gloucestershire and was hired as a tutor for the children of Sir John Walsh and Anne Poyntz and a preacher for the area.[13] He preached his translations of the New Testament from Greek, which would have been new for the area and different than any other preachers that came to speak.[14] In the Walsh household Tyndale came into contact with nobles and scholars of all calibers including King Henry VIII and Queen Anne Boleyn who in 1535 stopped at the house of Nicholas Poyntz, brother to Anne Poyntz, on their royal progress.[15]

Tyndale's main belief was that the common people should be able to read the words of the Bible, not just the clergy. At this time, Bibles were only available in foreign languages and so the common people needed the Church to translate the words of God. Tyndale arrived in London, where he believed he could better spread his word, around 1523 and was surprised by the lack of work for him to do. Lutheranism had taken hold in Germany by 1522 and was spreading throughout the continent. English officials were terrified of these new ideas and regulated the presses in order to ensure that power would remain with the Church.[16] Printing in England in the 1520s was not extremely productive. The three main printers were Caxton, Pynson, and de Worde and none of them would attempt to print a Bible because of the political atmosphere at the time. To provide a contemporary analogy, Daniell compares the printing of the Wycliffe Bible in 1520s England to the US Library of Congress printing copies of the Communist Manifesto in the 1950s.[17] These printers flooded the English market with lower quality printed material because they could not compete with the sophisticated printers of Antwerp, Paris, and Venice.[18]

Not finding an audience in London, Tyndale moved on to Cologne in 1525 where his first translations of the New Testament in English were printed freely.[19] The translation

had progressed to Matthew 22 when Tyndale and his assistant were chased out of the city by the authorities and escaped to Worms where he finished the rest of the translation.[20] Tyndale's intent to open the word of God to every Englishman was still highly controversial and illegal. He was hunted by many throughout his years of translation throughout the 1520s and 1530s.[21] In Worms Tyndale was temporarily safe and printed an octavo edition of his New Testament in 1526 with the help of his partner William Roye. This pocket-sized Bible was much easier to conceal and transport secretly.[22] In the same year in London, Thomas More and Cardinal Wolsey were raiding homes and businesses of supposed heretics and burning any suspicious books.[23] Tyndale, however, was using his many contacts to smuggle his New Testament through the North Sea Coast, a fairly common practice at the time. The unbound pages were stuffed in among other papers, textiles, glassware, food products, and any other cargo.[24] Tyndale's version was well in demand in England by 1526 and was making quite a profit despite the secrecy needed to purchase it.[25]

The first known burning of Tyndale's writings took place in October 1526 in London and soon copies were being ferreted out of homes across the country. Thomas More took it upon himself to find Tyndale and bring him to justice for his mistranslation of God's Word. More's hatred was so strong that he described Tyndale as "a hell-hound in the kennel of the devil…discharging a filthy foam of blasphemies out of his brutish beastly mouth".[26] At this time Henry VIII was still a favorite of the Church in Rome and condemned Tyndale and his ideas which only provided ignition to More's fire.[27] At the same time that Wolsey and More's "witch-hunt" was heating up, Tyndale parted ways with Roye and moved possibly to Marburg. He remained elusive but many of his contacts and relatives were questioned and imprisoned for supposed heresy.

At this critical moment Anne Boleyn, public sweetheart of the King, took the side of a few of the imprisoned booksellers and revealed her liberal leanings.[28] In 1528 King Henry VIII sent his first request to Pope Clement VII to relieve him of his dying marriage to Catherine of Aragon.[29] Clement could not allow the King his divorce so reformers like Tyndale became more appealing to the King. Boleyn probably owned the first run of Tyndale's New Testament and the British Library still possesses a later copy printed on vellum and richly decorated.[30] Tyndale then moved to Antwerp, which was a haven for Lutheran and other reform thinkers and a place that he could move freely without having to worry about being discovered. Here, though, Tyndale encountered a major threat. He published the *Wicked Mammon* prefaced by his own name and his pen name, William Hitchyns. In August of 1527 Roye published *A Brief Dialogue between A Christian Father and his Stubborn Son* that states that Hitchyns, aka Tyndale, wrote the New Testament. Here was hard evidence that Tyndale was the translator.[31] In June 1528 More and Wolsey forced an arrest warrant for Tyndale and Roye and paid handsomely to track the men down.[32] The search became more fervent as the Pope fought against King Henry's wishes for divorce and Wolsey's position, and life, hung in the balance because of it.

Even amidst this chaos Tyndale published *The Obedience of a Christian Man* on October 2, 1528.[33] With this brochure Tyndale planted the idea that the King should be the decider of heresy and rule by God's word, not the Pope. He said that a good Christian man would not resist his king because the King was in conversation with God.[34] Anne Boleyn quickly realized the significance these ideas would have to Henry VIII and gave it to him to read with certain critical passages marked. Even though Henry found these passages favorable, Tyndale was still much too reform for his tastes and so the manhunt continued

on.[35] In early 1529, Tyndale arrived in Hamburg without money or his books as his boat had crashed upon the shore.[36] Tyndale was able to recoup some of his losses when Bishops in London started buying the New Testaments to burn, allowing him to print more.[37]

In October of 1529 Wolsey completely fell out of favor with the King for not being able to solve his 'Great Matter' and More was promoted to first lay chancellor, giving him the freedom and resources to intensify his search for Tyndale.[38] Tyndale only returned to Antwerp to supervise the printing of his translations of the Old Testament, effectively creating the largest collection of print written in English.[39] With this great accomplishment came the first burning of a heretic by More in February 1530.[40] Soon after, More was not only burning heretics but also ignoring their right for a trial and fair imprisonment. It seemed that no one was safe.[41] Here Tyndale made a fatal error, he declared in his *The Practice of Prelates* that he could find no reason in the Bible for Henry to leave Catherine. This gave Henry a reason to want Tyndale gone.[42] In November of 1530, though, both Tyndale and Boleyn rejoiced for the death of Wolsey. The new player in the court now was Thomas Cromwell.[43] Cromwell was a seeming ally of Tyndale and Tyndale actually revealed himself to Cromwell's messenger in Antwerp in April 1531.[44] Tyndale agreed to submit himself to the King's wishes if only the King would let an English Bible be distributed in England.[45] By February 11, however, King Henry had declared himself head of the English Church and declared Tyndale's writing as "being filled with seditions, slanderous lies, and fantastical opinions."[46] Tyndale evaded search efforts during 1532, but More satisfied himself by burning many of Tyndale's supporters at the stake in the previous year.[47] More left Henry's services in May of 1532 when Henry decided to take over More's ability to

decide heresy cases. However, More continued to write against Tyndale.[48] He also used subtle means such as treatises to influence the King against his enemies.

In April 1533 King Henry announced that he had married Anne Boleyn and that she was with child.[49] This reduced the manhunt throughout England, as Anne was a sympathizer of Tyndale and his followers.[50] In 1534 Tyndale printed a new edition of his New Testament that featured more than 5,000 changes and Anne Boleyn owned a copy herself.[51] While in Antwerp Tyndale lived in the English House, owned by Thomas Poyntz – relative of Anne Poyntz from Little Sodbury.[52] Meanwhile, in April 1534, More refused to sign Henry's Act of Succession and was locked away in the Tower in danger of death by hanging and quartering.[53] While Tyndale was temporarily safe among his friends in the English House, Antwerp was becoming dangerous and though More was imprisoned, he was not without the power to write and direct.[54]

May 21, 1535 proved to be a fateful day for Tyndale. His new friend, Henry Phillips with whom he had dined and discussed all matters of religion, called upon him and lured him into the street where he was quietly arrested. Though Tyndale had trusted Phillips, it turned out that he was a staunch Catholic supporter.[55] Tyndale was taken to the Castle of Vilvoorde and his supporters rioted in the area. English officials were shocked by his arrest and asked for his release, but the matter was in the hands of Charles V who ruled the area. It was thought that Thomas More had funded Phillips, as no other heretics seemed to be in danger.[56] Phillips patron was unknown at the time but More had the motive, the will, the agents, and the support of Charles V.[57] The only problem with this assumption is that More was beheaded for his crimes on July 6, 1535. However, there is no reason that More could not have orchestrated Tyndale's arrest before his death.[58] Poyntz fought for Tyndale's

release but soon had to leave the country to escape his own death. Tyndale had to pay for his own jail cell by selling his books and materials.[59] By January of 1536 Catherine of Aragon had died and Anne Boleyn had miscarried for a second time, leaving Tyndale to fend for himself. Anne was beheaded on May 19, 1536 and the English Bible seemed more out of favor than ever.[60] At the beginning of August 1536 Tyndale was deemed guilty of heresy and stripped of his priestly status.[61] It was not until October 1536 that Tyndale was finally executed.[62] It is said that his last words were, "Lord, open the King of England's eyes."[63]

Every Bible in English after Tyndale owes much of its content to Tyndale's translations. Myles Coverdale printed his "Coverdale's Bible" in 1536 and also contributed to the Great Bible of 1539 and the Geneva Bible in 1560.[64] "Coverdale's Bible" was technically the first complete Bible printed in English and was dedicated to Henry VIII.[65] It borrowed directly from Tyndale's published translations of the Old and New Testaments.[66] Matthew's Bible was the next to be printed in 1537 by Thomas Matthew. Thomas Matthew was probably a pen name for John Rogers, a colleague of Tyndale, who again borrowed much from Tyndale's translations. This compilation of Tyndale and Coverdale was the first to receive a royal license to be printed throughout England without fear of persecution.[67]

After royal permission had been given for possessing an English Bible, they started to appear in churches throughout the country. However, Matthew's Bible was too outspoken for many readers and so Thomas Cromwell allowed Coverdale to revise the Matthew Bible and create the Great Bible in 1538.[68] After a political setback Richard Grafton and Edward Whitchurch finally printed the Great Bible in 1539. Six more editions of the Great Bible had been printed by the end of 1541.[69] Despite the popularity of the

Great Bible, the reading of the Tyndale version of the Bible was banned by Parliament in 1543 and then in 1546 King Henry banned both the Tyndale and the Coverdale Bibles.[70] All of these bans were removed when Henry died and his son Edward VI ascended the throne.[71] Queen Mary brought back her father's strict ideas and propensity for burning books and people, but left the Great Bible alone. Queen Elizabeth I called again for every parish to own a Bible in English and the Geneva Bible came about.[72] William Whittingham and others constructed the Geneva Bible in 1560.[73] This Bible was a revision of the Great Bible's Old Testament and a revision of Tyndale's New Testament.[74] Soon the Geneva Bible became the household Bible in England and had seventy editions by the time Queen Elizabeth died. The only downfall of the Geneva Bible was its outspoken Calvinistic views that were viewed as unfavorable by the Queen and English clergy. The answer to this problem was the Bishops' Bible, so called because the bishops of England composed it in 1568.[75] Finally in March 1603 the crown passed to King James I who decided that a new translation of the Bible in English needed to be produced, and so the King James Bible was organized.[76] Unlike the Geneva Bible, the King James Version would have no political or theological notes and would therefore be useful for the church and the people.[77] The first authorized version was printed in 1611 and is now known as the common "King James Version" popular in the US.[78]

Image 1. Silhouettes of Thomas Bond and Davies Giddy
(Cornwall Record Office. 1799. DG/124)

## 2. **Archival Research**

The Ohio State University Library does not have a record of the provenance of the 1566 Tyndale Bible, or when it came to Ohio State, so the writing on the added first and last pages was used to track some of the Bible's former owners. The families that wrote in the Bible were the Bonds and the Gilberts of East Sussex and Cornwall. The archives of these cities as well as the British Library were the starting point of my research in England, which was funded by the Undergraduate Research Office through the Undergraduate Research Office Summer Fellowship.

The East Sussex Record Office produced a history of the Gilbert family and biographical information about Davies Gilbert, formerly Davies Giddy. From the sheer volume of letters and correspondences concerning mathematics, physics, and geology Gilbert was clearly a large supporter of the sciences.[79] Gilbert also served as the President of the Royal Society from 1827 to 1830 and was a member for several years longer.[80] This interest in science translated to a large collection of books in Gilbert's personal library as well as an interest in printing. The Cornwall Record Office contains a few prints made by Gilbert, one of his daughters, and his wife in their home. They also hand-painted some of these prints with watercolors.[81] Gilbert's large fortune, which he inherited through his wife's family, allowed him to acquire and pass down many unique books including several

copies of the Bible. Among these Bibles were the Tyndale Bible in question, a copy of the Bishop's Bible, four other English Bibles, two from China, two from France, three from Greece, one in Gaelic, two in Hebrew, two in Latin, one from Maori, and one from Tuscany.[82] The Tyndale Bible was directly referenced in the inventory of the Trelissick Library in 1885 as well as in a letter to Mrs. Davies Gilbert from a W.H. Allnutt, presumably the same William Henry Allnutt that served as a senior assistant in the Bodleian Library and died in 1916. Allnutt stated that, "The New Testament on yellow paper is valuable independently of the… entries of the Bond family of Looe." The reference in the library inventory also mentions that the title page of the Bible was missing in 1885.[83]

Based on the writing within the Tyndale Bible it is clear that three generations of Thomas Bonds owned the Bible. As can be seen in Chart 1, the first Thomas Bond that is recorded in the Bible was born in 1689 and died in 1747 and served one term as mayor of East Looe. The second Bond was born in 1735, died in 1773, and was a Merchant and Grocer.[84] The final Bond to own the Bible was born in 1765 and died in 1837. This Thomas Bond served as Town Clerk for both East and West Looe and wrote a history of the two towns. He was well respected and worked in the service of the government for over forty years as well as a shorter time as a leader in the local military.[85] Bond left his estate and many of his possessions to his second cousin Davies Gilbert.[86] Davies Gilbert was not only involved in the Royal Society but also served as a Member of Parliament in the House of Commons.[87] The hand of Gilbert can be seen in the pages of the Bible where he recorded the death of his cousin and friend. From here the path of the Bible is not recorded and can only be inferred. The will of Davies Gilbert states that his estate was passed to his daughters and all of his books were given to his wife who was involved in her husband's

Royal Society work.[88] Following the death of Mary Ann Gilbert the Bible was passed down to her son[89], John Davies Gilbert who then bequeathed all of his books to his sister Hester Elizabeth Gilbert-Holmes.[90] Hester gave the Bible, as well as her other books, to her nephew Carew Davies Gilbert, John Davies Gilbert's son, and he in turn gave them to his wife Grace Catherine Rose Massy-Dawson Gilbert. [91] It is known that the Tyndale Bible was in the collection at the Trelissick Estate until at least 1885. The house was bought in 1913 by Leonard Daneham Cunliffe who left it to his stepdaughter Ida Copeland. Ida gave the house to the National Trust as well as the garden area in 1955. Ida's living relatives still reside in the part of the Estate not owned by the Trust.[92]

Following 1885, the last time the Bible's location was documented, the Bible was presumably included in one of the Estate auctions and eventually donated to The Ohio State University. The whereabouts of the Bible previous to ownership by the Bonds is unknown. The printer of the Bible was Richard Jugge, appointed printer of Queen Elizabeth. Jugge worked in London near Christ's Church and produced three illustrated quarto editions of the Tyndale Bible; 1552, 1553, and 1566.[93] To summarize, the Tyndale Bible in question was produced in London in 1566 and within the next century made its way to East Looe and eventually to Columbus, Ohio.

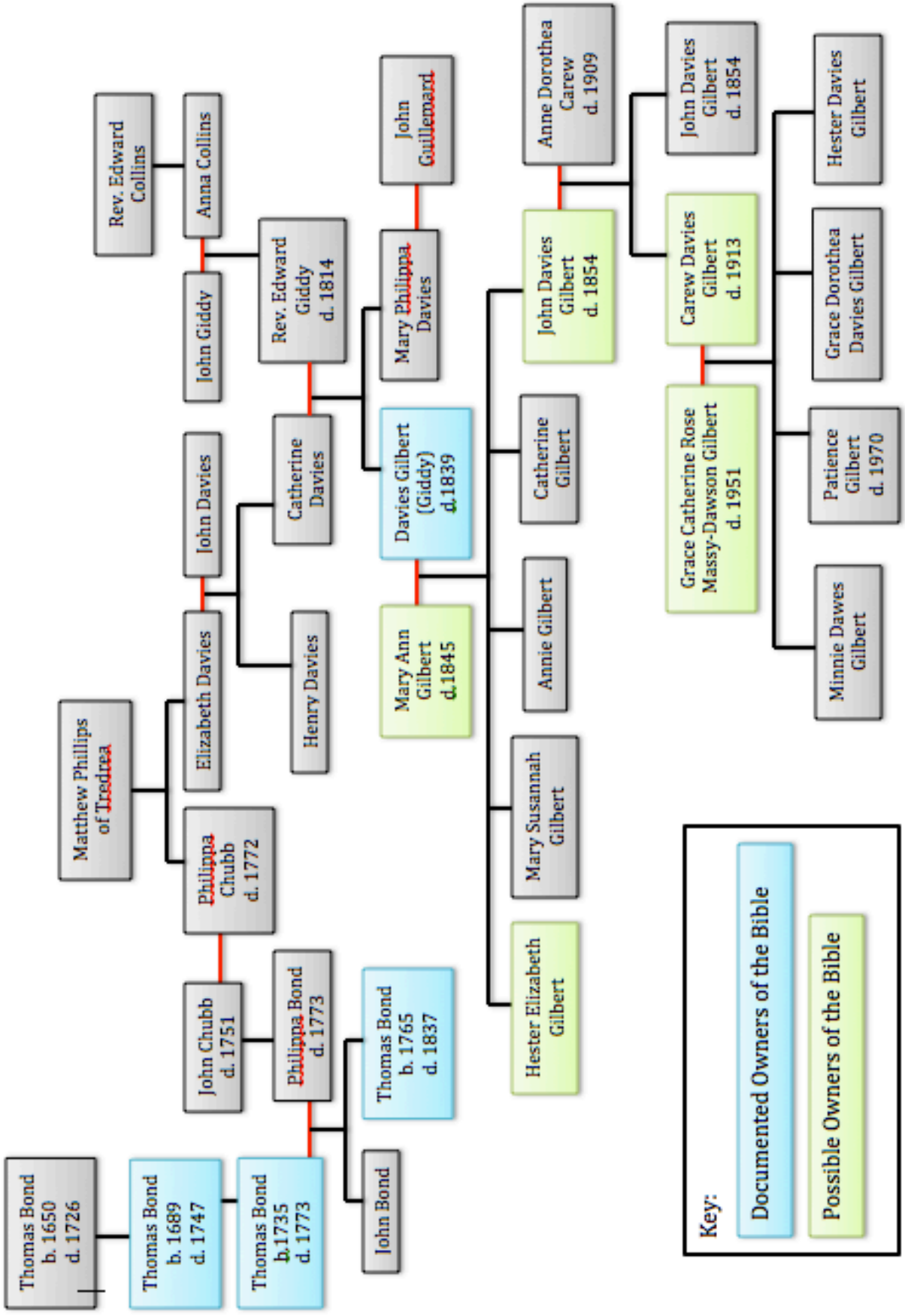



Chart 1. Genealogy of the Bond family and his relatives, demonstrating the ownership of the 1566 Tyndale Bible in the 18th and 19th centuries

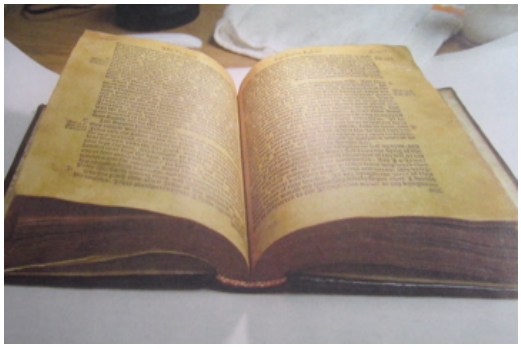


Image 2 & 3. Images of the 1566 Tyndale Bible now located at The Ohio State University (Harry Campbell, "Conservation Treatment Report for Tyndale Bible – New Testament, 1566")

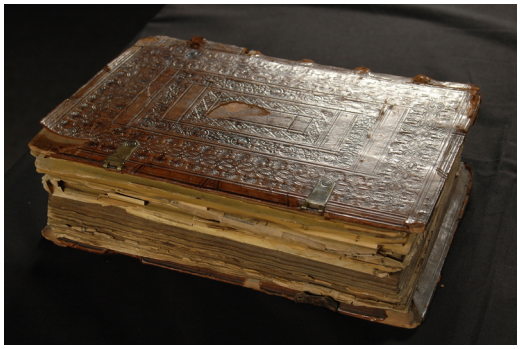


Image 4 & 5. Images of the 1553 Bible printed by Bergaigne now located at the University of Ghent (Serafien Hulpiau, University Library Ghent – Belgium)

### 3. Other "yellow" books from the sixteenth century

Through inquiries made throughout the rare book community, examples of other "yellow" books have come up. The first is that of a Bible printed in 1553 by Anthoni-Marie Bergaigne, a printer with the University of Leuven in Belgium.[94] This Bible contains the old and new testaments and appears to have been "painted" before it was bound. The Bible was inaccessible at the time of this study but the color of the coating appears to be similar to that on the Tyndale Bible. No research could be done on the Bergaigne Bible so it cannot be proven whether these coatings are similar.[95] The University of Leuven was a progressive Catholic university in the sixteenth century and may have encouraged experimental techniques like this yellow coating.[96]

Interestingly, a majority of the other examples of "yellow" books found are other copies of Bibles from the same era as the Tyndale. Durham Palace Green Library has a 'Great Bible' printed by Richard Grafton in 1541 in London.[97] This Bible is said to be colored with a saffron dye.[98] This identification has not been undeniably proven and Dr. Natalie Mears of Durham University states that, "while its precise significance is unclear, it assimilates these paper books to parchment ones, enhancing their venerability."[99] The British Library has several bibles listed as having "yellow paper". One is *The Bible in Englishe according to the translation of the great Byble* printed by Richard Grafton in 1553 in London.[100] Grafton was the royal printer for King Henry VIII and his son Edward VI who died in 1553. He declared himself the royal printer of Lady Jane Gray but was then thrown into jail for the act upon the accession of Mary I to the throne.[101] It is clear that Richard Jugge and Grafton were printing at the same time but it is not clear how much interaction they had with each other. Another Bible printed by Grafton and his partner Edward Whitchurch in 1537 was also printed on yellow paper.[102] This Bible is commonly called "Matthew's Bible", Thomas Matthew being a pseudonym of the editor. However, the Matthew Bible draws heavily on the Tyndale but was not directly associated with Tyndale and therefore not dangerous to possess at the time.[103] Another copy of the 1537 Matthew Bible was also printed on yellow paper and both of these two Bibles were printed in Antwerp. [104] Another yellow-papered Bible was printed in 1545 in Leiden and later compiled by Otto Brunfels.[105] The final yellow Bible in the British Library is a Dutch version printed by Johannes Cloppenburch in Amsterdam in 1613, much later than the others.[106] A 1536 Tyndale Bible printed in Antwerp, now located at the University of Michigan, also

features yellow coating but only on part of a single page. The coating covers the area of a woodcut illustration but otherwise is not present.[107]

The only volume that is noted as having yellow pages from this time period owned by the British Library that is not a Bible, is a copy of the Works of Homer printed in 1551 by Nicolaum Brylin and Bartholomæum Calybæum.[108] Bruce McKittrick Rare Books, Inc. sold two other "yellow" books several years ago. The two books were Justus Lipsius' *Ad Annales Cor. Taciti Liber Commentarivs* and Josias Mercier's *Ad Novam Taciti Editionem aliquot Notæ*. A. Drouart printed both volumes in Paris in 1599. They were listed as having pages covered in saffron to produce a yellow/green tint. The coloring was added after printing but before binding, possibly at the request of the buyer. The amount of tinting varies from page to page which is listed as a result of the differing amounts of the "vegetable dye" used on the pages. The listing also cites that documents printed on blue paper indicate luxury and green paper was reserved for Hebrew documents.[109]

Scientific Research

1. **Conservation Science**

The science of art conservation is a quickly expanding field that has extended its boundaries past basic restoration and into the realm of high-tech instrumentation and experimentation. The ability to restore a work of art, whether it is a painting, a statue, or a document to its original state is highly valued by museums, collectors, and artists. Only recently has the technology become available to allow conservationists to not only restore a piece of work but also to analyze what is occurring on a chemical level. Methods such as scanning electron microscopy, energy dispersive spectrometry, UV-Vis spectrometry, X-ray fluorescence, Near Infrared spectroscopy, and Raman spectroscopy can be used to identify pigments in a painting or manuscript as well as the presence of a previous restoration attempt. These methods can also be used to monitor the stability of an artifact or artwork during the conservation process and even to replicate materials needed for conservation of a deteriorated textile.

| Element | Tyndale Bible Paper (counts) | Reference Paper (counts) |
|---|---|---|
| C | 21059 | 28935 |
| Na | 994 | No peak |
| Mg | 1028 | No peak |
| Al | 2485 | 810 |
| Si | 3476 | 962 |
| P | 1137 | 737 |
| S | 5686 | 1139 |
| Cl | 1178 | 743 |
| K | 2387 | 580 |
| Ca | 3177 | 1417 |
| Fe | 409 | 223 |
| Cu | 193 | 165 |

Table 1. Results from Energy Dispersive Spectroscopy (Olesik and Bhattiprolu, "Analysis of Paper from the Bible," pg. 4.)

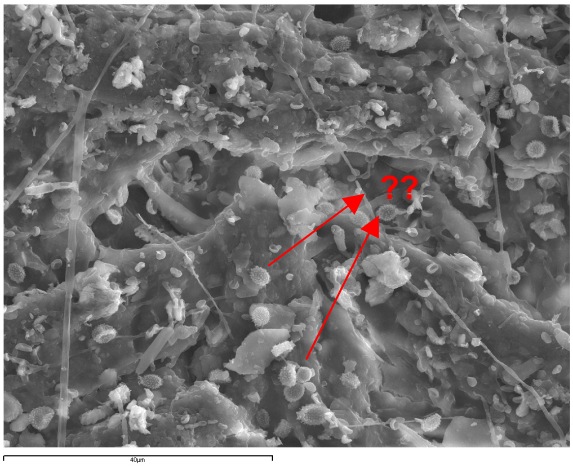
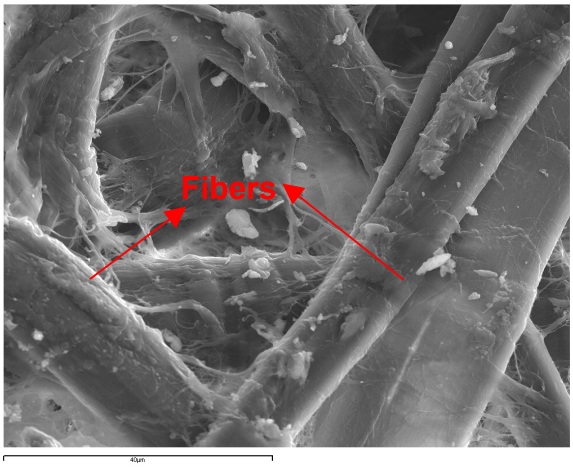
| | |
|---|---|
|  |  |
| SEM image of the brown paper at a magnification of 1500X. | SEM image of the white paper at a magnification of 1500X. |

Image 6 & 7. Results from Scanning Electron Microscopy of the Tyndale Bible paper and reference paper (Olesik and Bhattiprolu, "Analysis of Paper from the Bible," pg. 2.)

## 2. **Research undertaken in 2005**

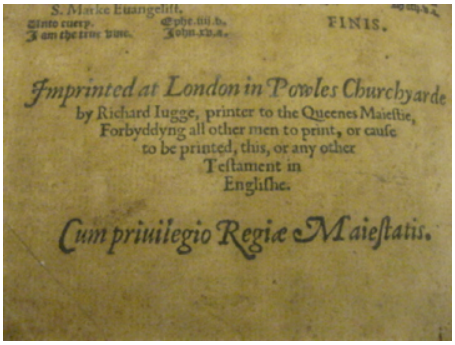
The previous research conducted on the Bible was carried out in 2005 by the Microscopic and chemical Analysis Research Center at The Ohio State University and includes analysis by scanning electron microscopy (SEM) and energy dispersive spectrometry (EDS).[110] Small sections of the paper in question (3 mm x 3 mm) were placed on an SEM stub and coated with a thick layer of carbon. Images of both the Tyndale Bible paper and sixteenth century type reference paper were obtained at several magnifications. The Bible paper contained spores of organic material as well as a thick coating of inorganic "paint" on top of regular paper fibers. The reference paper showed no signs of the spores and the fibers of the Reference and Bible papers were easily distinguishable from each other.[111]

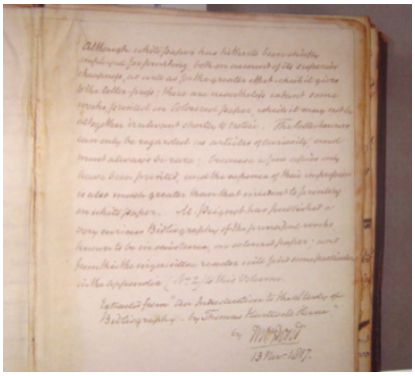
The EDS spectra taken of 3 mm x 3 mm samples of each type of paper also showed that the Bible paper contains higher levels of every inorganic element, especially sulfur and calcium, whereas the reference paper contained higher levels of carbon. An EDS spot analysis was performed to compare the content of a spore on the yellow paper to another crystalline structure also found on the yellow paper. The main difference was the carbon count, with the organic spore containing sixteen times the amount of carbon as the crystalline structure. The conclusion that can be drawn is that the spore itself is covered with an inorganic "paint." The crystalline structure could be part of this "paint" and, therefore, the yellow color is due to a mixture of organic and inorganic materials like a binder and pigment. Testing was concluded at this point because the object of the testing was to ascertain whether the yellow paper contained arsenic or any other harmful materials, which it does not.[112]


Image 8. Setup for Raman Spectroscopy and Attenuated Total Reflectance Spectroscopy (Harry Campbell, 2009)

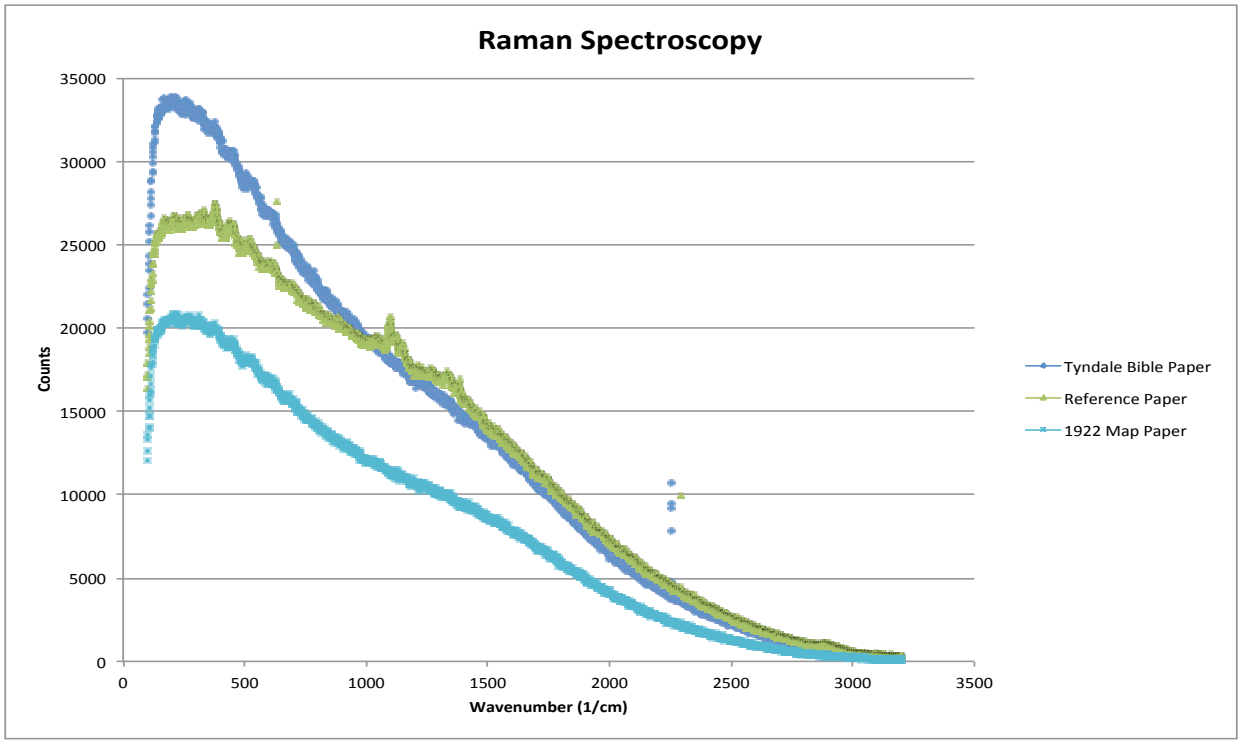
3. **Research undertaken between 2009 and 2012**

All of the tests carried out on the Tyndale Bible were nondestructive. The center of the Tyndale Bible pages was used as the testing surface whenever possible in an attempt to remove the chances for interference by any oils or grime that may have deposited on the edges of the pages. When a smaller sample was necessary, corners and edges of pages that had become separated from the Bible due to age were used. The reference paper sample was a piece of rag linen paper from the sixteenth century, similar in all appearances and composition to the Tyndale Bible paper outside of the yellow coating. The sample referred to as beeswax paper is a piece of the reference paper painted with a beeswax and turpentine coating. This paper is further described in the non-analytic testing section. The final sample used during testing was a piece of a map from 1922 that had a thick coating of shellac. The shellac had aged to a similar yellow color as the Bible but was significantly more brittle. The important results of each test will be italicized for the sake of clarity.



Images 9, 10, & 11. Images from the 1566 Tyndale Bible: Left: the final page showing the printer's attribution, Center: The residual edges of the Bible, Right: A plain page inserted by the Bond family in the 18th century (Harry Campbell, "Conservation Treatment Report for Tyndale Bible – New Testament, 1566")



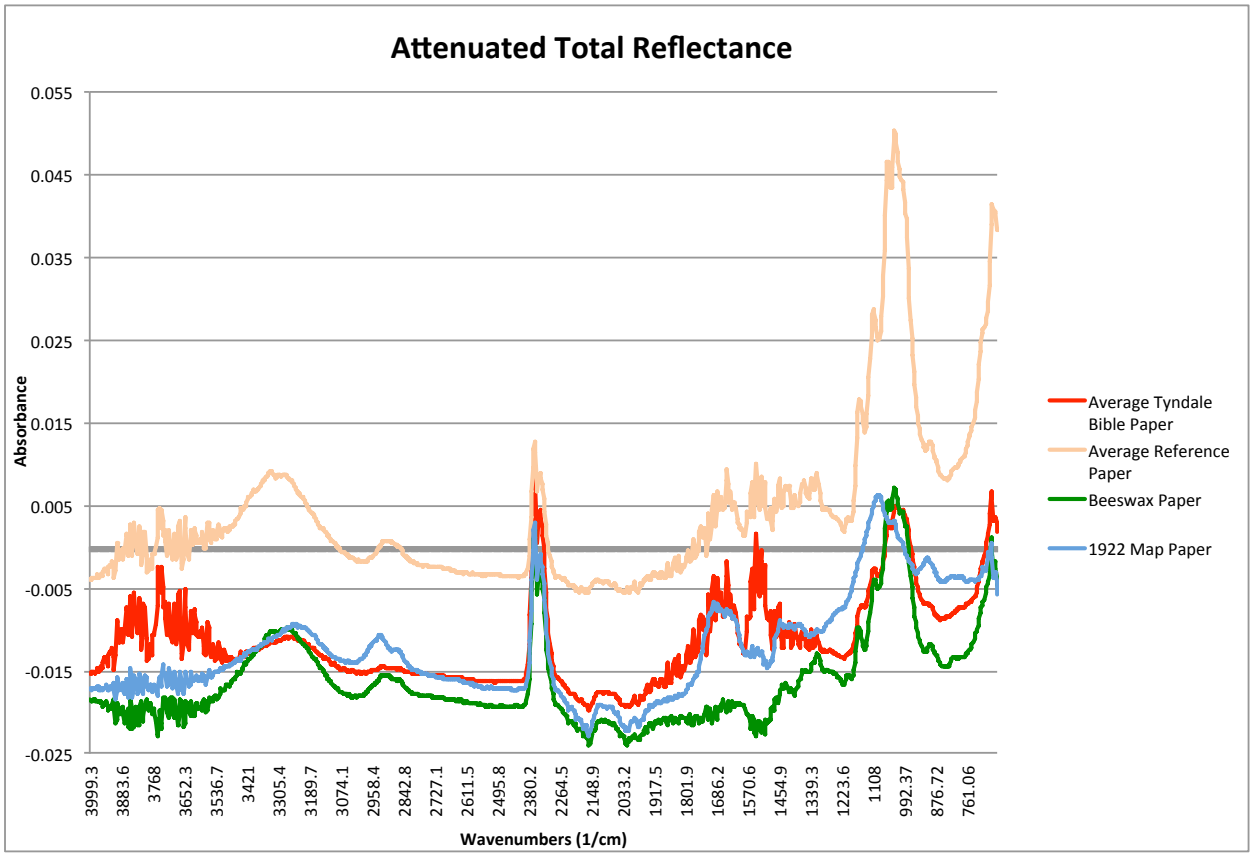

Graph 1. Raman Spectra of Tyndale Bible Paper, Reference Paper, and Map Paper

a. **Raman**

Raman spectroscopy can be used to reveal the structure of a sample by displaying the organic bonds within that sample. Recently, Raman spectroscopy has been used to identify pigments in manuscripts of various ages.[113] This was the first test carried out on the Tyndale Bible with the Renishaw - Smiths Detection Combined Raman - IR Microprobe. Different types of paper, including modern printer paper, a business card, and sixteenth century sample paper, were utilized to perfect the sampling method. It was found that the best spectra were obtained by inserting a small sample of paper in between two glass slides and attaching the bottom glass slide to the sample stand with "sticky tack". Based upon previous literature, the longer wavelengths produce higher quality spectra with paper type samples.[114,115] Testing on the paper samples therefore began at 514 nm and progressed to 785 nm. The scans were recorded between 100 - 3200 $cm^{-1}$ at several

intensities, ranging from 0.0001% and 100%, and integration times between 10 s and 100 s. At 514 nm, the plain sixteenth century paper fluoresced even at 1% intensity. Increasing the duration of the scan did not improve the quality of the spectra and no reproducible peaks were present. The Tyndale Bible paper did not fluoresce at low energy but still produced no peaks at higher energy. The results from the 785 nm excitation were marginally more reproducible but less fluorescent. During the 60 second scans two small peaks located between 1000 and 1500 $cm^{-1}$ could be observed on the reference paper. These bumps were sometimes present in the Bible paper and therefore are indicative of the paper and not the coating. The intensity had to be kept low for a majority of the tests to avoid bleaching the paper samples but the only noticeable peaks, those mentioned above, were not present at intensities higher than 50%.

*Overall, the high rate of fluorescence and the lack of distinguishing peaks reduced the effectiveness of Raman spectroscopy for distinguishing these samples making this method inconclusive.*



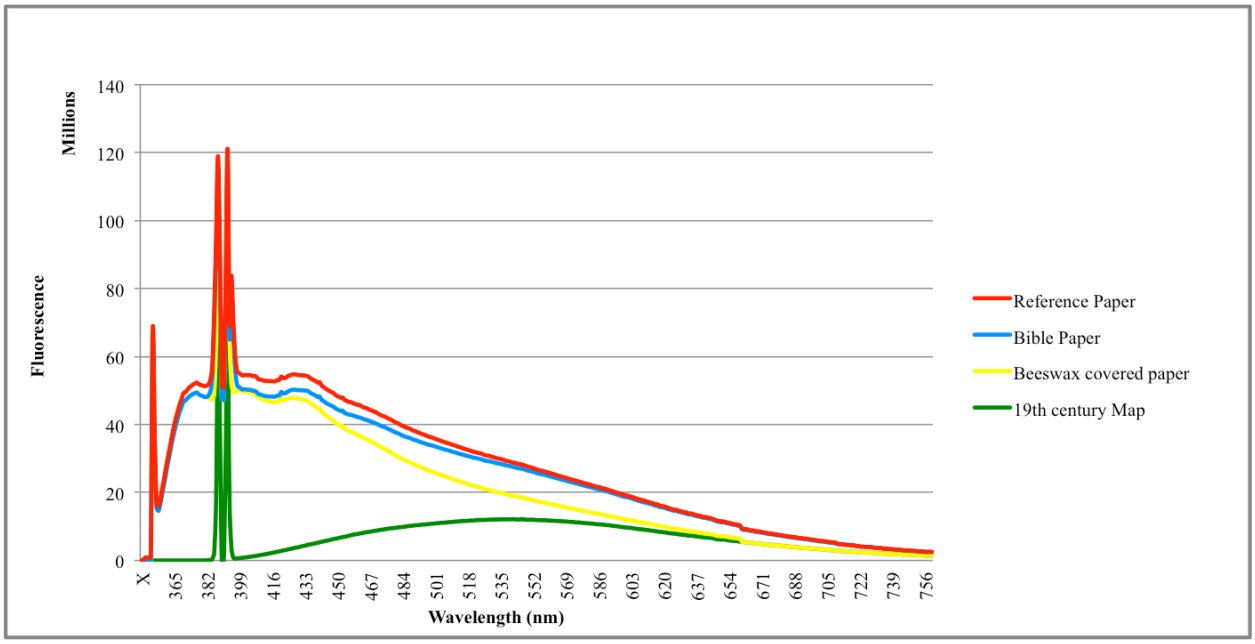

Graph 2. Comparison of the Attenuated Total Reflectance Spectra of the Tyndale Bible paper, reference paper, Beeswax paper, and 1922 Map Paper

b. **ATR**

Raman spectroscopy seemed to be promising but the laser permeated through both the coating and the paper, not revealing the composition of just the coating. Attenuated Total Reflectance (ATR) spectroscopy, therefore, should provide an analysis of the coating by itself. The evanescent wave produced by the internal reflectance of the ATR crystal only allows penetration of 0.5 to 5 microns into the sample.[116] Though the coating seems to have seeped into the Bible paper somewhat, the ATR may be sensitive enough to differentiate the paper and the coating. In order to test the center of the Tyndale Bible pages the slides were placed underneath each page and slid into place on the sample stand. The slide was secured to the sample stand again with "sticky tack" to reduce the possibility of tearing the paper when adjusting the height of the lens as the ATR objective had to be in direct contact

with the sample paper. Several different pages and positions were tested within the Tyndale Bible in order to determine if different areas revealed different spectra. Targeted areas included the center of the page, the edges of the page, large areas of ink coverage, and pages with varying amounts of coating. The ATR objective used was diamond and the testing was done at 785 nm with the Renishaw - Smiths Detection Combined Raman - IR Microprobe. The scans were recorded between 100 and 4000 $cm^{-1}$ at 8 and 4 $cm^{-1}$ resolutions. Any peak located at 1350 $cm^{-1}$ is due to the diamond objective and negative peaks may be a result of residual methyl alcohol used to clean the objective. The Tyndale Bible Paper and the sixteenth century reference paper both returned reproducible spectra at an 8 $cm^{-1}$ resolution setting. The coating on the Bible paper did reduce the percent absorbance of the paper. Because of the similar appearance and texture of the beeswax-covered paper, a spectrum of this sample was taken as well as a spectrum of the 1922 shellac covered map. The shellac was known to be of a different composition than the Bible paper, but the spectra were still fairly similar – possibly indicative of the similar color and possibly similar components. However, the beeswax-covered paper had a similar level of absorbance to the Bible paper and the peak around 1000 $cm^{-1}$ is most similar in energy to the beeswax paper.

*Based upon these observations it may be reasonable to conclude that one of the main constituents of the Tyndale Bible coating is beeswax.*



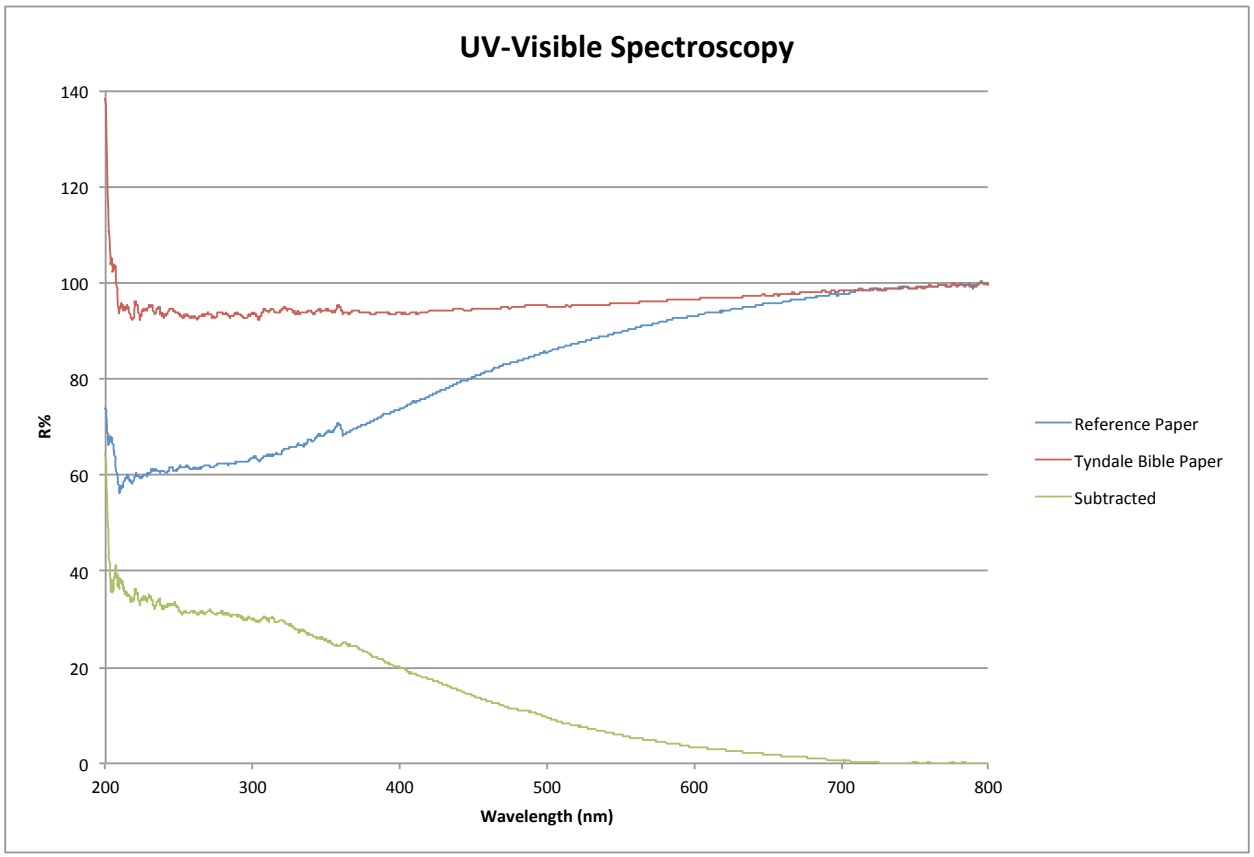

Graph 3. Comparison of the Emission spectra of the Reference paper, the Bible paper, the Beeswax paper, and the Map paper

c. **Emission**

Due to the strong fluorescence of the Tyndale Bible paper, fluorescence emission testing was an obvious method of analysis. The Cary Eclipse Fluorescence Spectrophotometer was used to measure emission with an excitation and emission slit width of 5 nm. Excitation was expected around 500 nm and so the scans were taken initially from 400 nm to 650 nm at medium scan speed and then expanded to a range of 350 nm to 800 nm when features were observed near 400 nm. The limited amount of testing did not allow for the exact identification of individual chromophores. However, a comparison of the resulting spectra of the Tyndale Bible paper, the sixteenth century reference paper, and the nineteenth century map clearly indicates a major similarity between the Tyndale Bible paper and the beeswax-covered paper. Each spectra displayed peaks around 388 and 395 nm. However, the nineteenth century map paper did not

fluoresce below 382 nm, the first peak, and had a very different fluorescence intensity at wavelengths longer than 395 nm.

*Thus it can be definitively determined that the coating is not a shellac but instead wax based and most likely beeswax.*




Graph 4. Comparison of the UV-Visible Diffuse Reflectance Spectra of the Tyndale and Reference paper

d. **UV-Visible Diffuse Reflectance Spectroscopy**

A small sample of the Tyndale Bible paper was placed underneath a lamp emitting near ultraviolet light and appeared dark purple, suggesting an organic composition. This was to be expected from a rag paper with at least a partially organic coating and lead to analysis with UV-Visible Diffuse Reflectance Spectroscopy. UV-Vis Spectroscopy is traditionally used to identify the components of liquids using an absorption spectrum.

Recently, however, solids and pigments have been tested using a reflectance spectrum. Either the absorption or reflectance spectra will reveal the structure of the conjugated pi-bonds in a complex organic molecule. By identifying the types of bonds in the coating, the contributing components of the coating may be able to be determined.[117] The Cary 100 UV-Vis Spectrophotometer was used for the diffuse reflectance testing. The small samples of each paper were placed on top of a Barium Sulfate reference plate in the solid sample holder in order to prevent any reflection from background sources. Each scan ranged from 200 nm to 800 nm with a data interval of 0.2 nm. A sample of the plain sixteenth century paper was tested and returned a fairly reflective sample with possible peaks around 350 nm. The Tyndale paper sample reflected the incoming light strongly and no peaks could be determined.

*Peaks in the spectra were not reproducible and a subtraction of the plain paper sample spectrum from the Tyndale sample spectrum removed any possible distinguishing characteristics. The coating on the paper is highly reflective and makes UV-Visible spectroscopy an ineffective method of testing.*

| | Front Added Pages (Newer) | Front Added Pages (Older) | Original Yellow Pages | Back Added Pages (Older) |
|---|---|---|---|---|
| Number of Pages Sampled | 5 | 3 | 17 | 3 |
| Highest value | 4.57 | 4.36 | 5.64 | 4.92 |
| Lowest value | 4.07 | 4.12 | 4.21 | 4.53 |
| Average pH | 4.34 | 4.25 | 4.996 | 4.76 |

Table 2. The pH values of various pages within the 1566 Tyndale Bible

e. **pH Testing**

The pH content of paper is important to analyze because acidic paper can become brittle and yellowed to the point of flaking. Most paper produced in Europe before the 17th century was made with rag linen without any aluminum or rosin sizing.[118] The addition of aluminum and later rosin sizings increases the rate of cellulose breakdown and adds to the acidity of the paper, which reduces its lifetime to only a few hundred years. After 1850, paper also shifted from rag linen to wood pulp.[119] Wood pulp paper is much weaker than rag linen and becomes acidic and brittle much more quickly. Unsized rag linen paper should keep a low acidity unless it is in contact with wood pulp paper, bindings, or frequently exposed to UV light or heat.[120] The Tyndale Bible paper, specifically the original (1566) paper, is a rag linen paper produced before aluminum sizing was widely used and should have a fairly low acidity. The white pages presumably added into the book in the eighteenth century are probably sized and should have higher acidity levels. Fresh, unsized paper should have a fairly neutral pH - between 6.5 and 7. A portable pH meter was used to test the pH of the Tyndale Bible paper, both yellow and white pages. The pH meter consisted of a combined electrode that tested the level of the hydrogen ions within the sample. A few droplets of water were placed on the corner of the page to be tested (this did not damage the sample because the coating on the pages is not water soluble) and the electrode was placed on the wet area. The average pH of the original yellow pages was

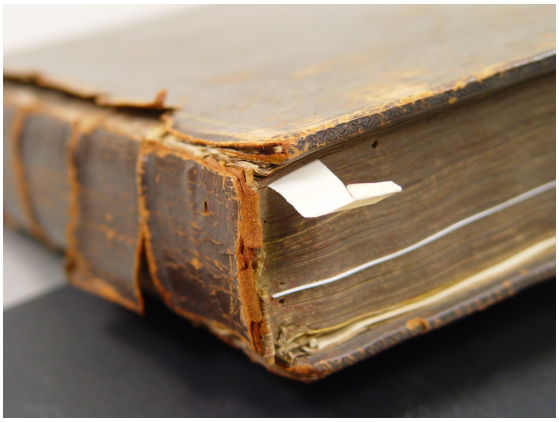
4.99. The average pH of the added pages in the back is 4.76 while 4.25 and 4.34 were the average pH values of the two sets of added white pages in the front of the Bible.

*All of the pages are more acidic than they originally should have been. Although, as expected, the older yellow pages are less acidic than the newer white pages. The surrounding white pages may have added to the acidity of the yellow pages over time.*

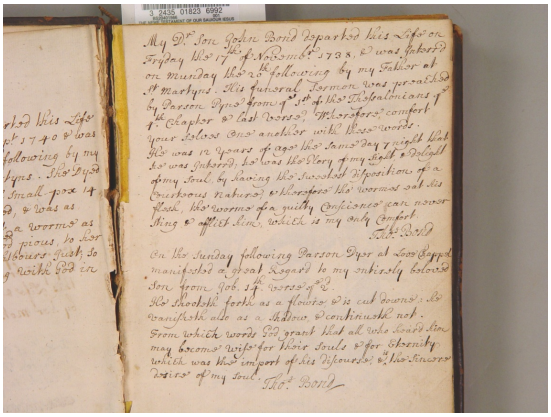
f. **Non-analytic Testing**

Some non-analytic testing, which includes the application of Damar Varnish and beeswax, has also been done on plain paper from the same period as the Bible paper. The Damar Varnish crystals were dissolved in turpentine and brushed onto sixteenth century reference paper. Another sheet of sixteenth century reference paper was brushed with raw beeswax dissolved in turpentine. The Damar Varnish diffused on the paper and did not retain the individual brushstrokes that can be seen on the Bible paper. The beeswax dissolved in turpentine retained the brush strokes but retained an obvious wax layer not apparent in the Bible.

*From these results as well as the previous testing it appears that the yellow coating is actually a waxy substance, most likely beeswax and turpentine, with yellow dye or pigment added for color.*



Images 12 & 13. Before (left) and after (right) treatment of the binding of the 1566 Tyndale Bible (Harry Campbell, "Conservation Treatment Report for Tyndale Bible – New Testament, 1566")




Images 14 & 15. Before (left) and after (right) treatment of the attached pages at the front of the 1566 Tyndale Bible (Harry Campbell, "Conservation Treatment Report for Tyndale Bible – New Testament, 1566")

## Conservation

No documented conservation took place on the Tyndale Bible until 2006. In 2006 Harry Campbell of The Ohio State University assessed the Bible and carried out basic treatment. His assessment concluded that the existent binding dated to the late 18th century and was composed of calf-skin with end bands of wooden strips and silk that was badly worn on all edges and joints. The sewing threads dated to the late 18th century as

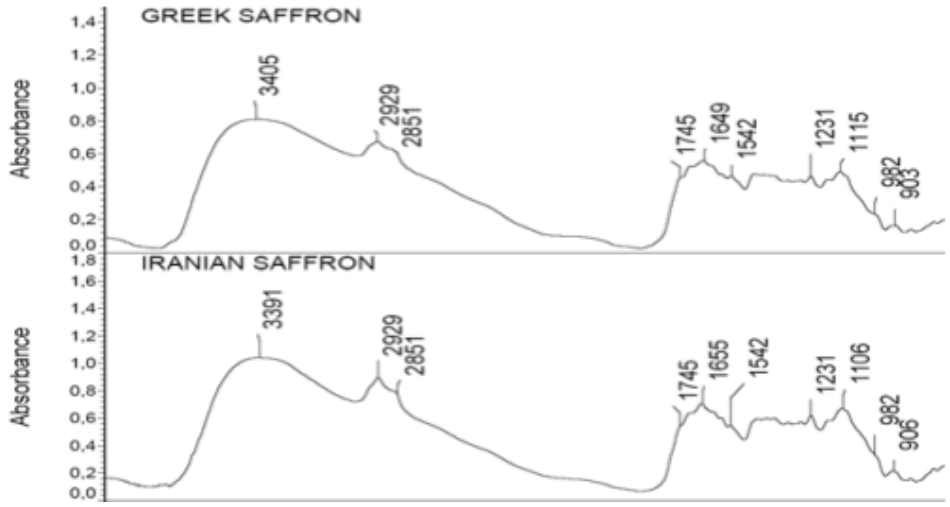
well and were white, not colored like the pages. The treatment undertaken in 2006 consisted of removing the binding and consolidating it with Japanese tissue and cotton muslin. The tipped-in pages at the front and back were removed, flattened, and re-attached with Japanese tissue hinges. New end bands were fabricated to match the style of the 18th century bindings. A new leather spine was applied beneath the 18th century leather spine for reinforcement and the damaged edges of the boards were consolidated. The yellow pages were left alone with the exception of minor mends.[121]

Future conservation recommendations include leaving the yellow pages as-is to protect the unique quality of the Bible as well as storage in a climate-controlled facility. After the steps taken in 2006 the Bible is in stable condition and should remain that way for many years. Any contact with extreme temperatures, UV light, insects, and water should be avoided.[122]

Discussion

While many of the analytical tests were inconclusive, they did provide clues as to the origin of the Bible and the composition of the yellow coating. Based on these results, it is likely that the base of the yellow coating is beeswax dissolved in turpentine. Beeswax has been used throughout history as an adhesive and in encaustic painting.[123] It is also used as a consolidant during the conservation of paintings.[124] Beeswax is used in varnishes to produce a matte finish on paintings or other materials.[125] Beeswax has different appearances depending on the locality but overall it is the most common natural wax.[126]

Many institutions that own the other yellow Bibles have determined that they are intentionally tinted with saffron. Saffron has been used for centuries as a fabric dye and food colorant.[127] Other uses include a substitute for gold in manuscript writing and also as a yellow colorant when painting over metal leaf, especially on altarpieces in the 17th and 18th centuries in Europe.[128] There is a record of saffron being used in 11th century Islam to give an antique effect to the paper.[129] In another instance, it was recorded that saffron syrup was used for medicinal purposes. Dishonest men would soak a paper colored with saffron in spirits and the yellow color of the paper would color their spirit. They would then sell the colored spirit as saffron syrup to unsuspecting buyers.[130] It is true that saffron has a bright yellow color but even Grove's Encyclopedia states that saffron, "should never be assumed to be present without chemical analysis, nor should written descriptions be accepted without caution."[131] There is no solid evidence that saffron was used in any of the yellow books mentioned above. Though it is expensive, saffron was produced in England and not uncommon.[132] In a study done to determine differences in localities of saffron the FTIR spectra of the saffron did appear similar to the ATR spectra of the Tyndale Bible paper. However, the basic spectral pattern was also seen in the reference paper so the spectra alone cannot confirm that saffron is present in the Tyndale Bible paper samples.[133] Without knowing if saffron is the agent responsible for the yellow color, other possibilities include yellow ochre, a very common pigment composed of iron oxide.[134] Iron is present in a larger quantity in the Tyndale Bible paper than in the reference paper.[135] Many other yellow pigments are lead based and because lead was not found in any abundance on the samples those can be eliminated. Yellow dye could also be extracted from various organic



Graph 5. FTIR spectra of samples of saffron from Greece and Iran. (E. Anastasakia et al., "Differentiation of Saffron from Four Countries by Multivariate Analysis of Mid-Infrared Spectroscopy", 11.)

sources such as buckthorn berries, but these organic dyes are very difficult to distinguish with testing.[136]

As there are no literary records available to explain the yellow coating on the Tyndale Bible, or any other yellow books, only theories can be proposed. Due to the close proximity of the locations and dates of a majority of the yellow Bibles uncovered, it is possible that this practice was a fad started in the 1530s and ending around the turn of the next century. The earliest example is from 1537 when a majority of the Bibles were printed in London where the printing community was small. The yellow dye could have been a trade secret that was shared throughout the printing community or passed down from one printer to another. Traveling between London, Amsterdam, and Antwerp was not uncommon either and printers likely corresponded with other printers in these cities. Even if all of the yellow Bibles have the same coating because their printers were in conversation, that does not answer the question of why.

One theory is that of deception. Throughout the 1520s, 30s, and 40s various versions of the Bible were being transported throughout many countries and possibly

collected and burned. The process of shipping the Bibles from the Continent to England normally involved leaving the individual pages unbound and disguising them among luggage, supplies, or other goods. A yellow page may be easier to hide among other items in a carriage filled with hay. Transporters of these Bibles, especially the Tyndale version, risked their lives to distribute their precious cargo and would want to be as inconspicuous as possible. This explanation is unlikely for any "yellow" versions of the Bible besides the Tyndale.

Another reason for the yellow color could be an effort at conservation from the elements and insects. Originally the Bible was analyzed for the presence of arsenic because a similarly colored yellow coating can be found on ancient Japanese documents and even some documents from dynastic Egypt. The arsenic dye on those documents is more commonly known as orpiment and was used through the 18th century.[137] Because these Bibles were valuable and encountered wind, rain, and sun throughout their travels, the yellow coating could have been applied to protect the pages. Testing on the 1566 Tyndale Bible has shown that, at this time, the coating is effectively water resistant. Wormholes in the Bible are evidence that the coating is not as toxic as the orpiment pigment is. The printers or another in the papermaking or binding process could have used ancient methods to protect their work.

The final theory, and the most likely, is that the yellow coloring was meant to make the Bibles appear more expensive. Rag paper, like that of the 1566 Tyndale Bible, was common and not unusual for printing. Materials such as parchment and vellum, however, were much more expensive and rare. Anne Boleyn's 1534 Tyndale Bible was printed on vellum and illuminated with expensive inks and gilding. Vellum appears much more yellow

than rag paper and any lesser noble that could not afford the vellum might opt to keep up appearances by dyeing their Bible. Because it appears that many, if not all, of the yellow Bible examples were colored either before or right after printing, and a large amount of effort was put into coloring each page, it follows that these Bibles would be considered to have a higher value.

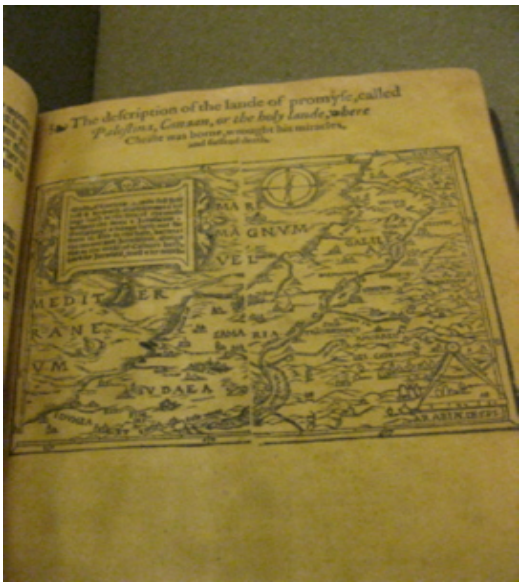
## Conclusion

As was stated above, no concrete conclusions can be made from the archival research or from the analytical research. The most likely theory, however, is that the printers in the sixteenth century wanted to make their Bibles appear more expensive and so they developed a method to make their wares more desirable. Their method was to paint each page of the Bible with a beeswax and turpentine mixture colored with saffron or yellow ochre. The more exciting theory involves painstakingly painting each page of the Bible and then sending them off unbound to travel throughout the land. This may be a possibility for the Tyndale Bibles of the 1530s and 1540s but otherwise does not make sense. It is also true that bookmakers wanted their books to last for as long as possible, but the rarity of this treatment does support a united effort at conservation. Though it may never be known why the 1566 Tyndale Bible is yellow, it will always hold a unique place in the colorful history of the Bible in English.

## Supplemental Images

1. A corner of the 1566 Tyndale Bible, owned by the Ohio State University, demonstrating the color (Ashley Bartman, 2010)

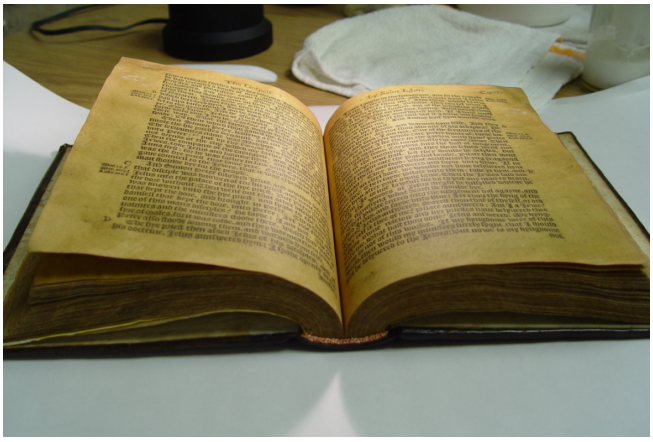
2. The inside cover and first page of the 1566 Tyndale Bible, demonstrating the 18th century page color (Harry Campbell, "Conservation Treatment Report for Tyndale Bible – New Testament, 1566")



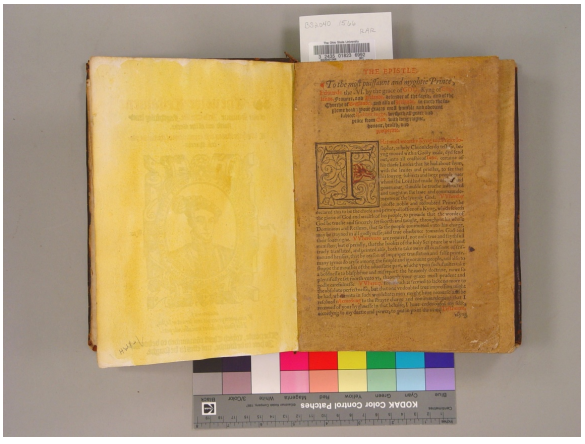
3. An example of a page within the 1566 Tyndale Bible (Ashley Bartman, 2010)

4. The dedicatory title page of the 1566 Tyndale Bible, painted yellow with watercolor (Ashley Bartman, 2010)

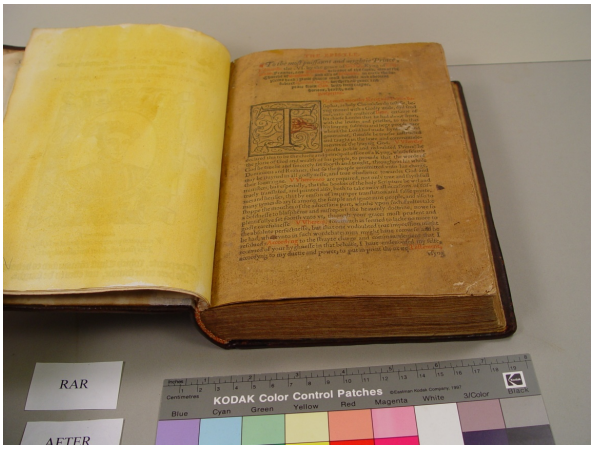
5. Un-stained sewing thread, indicating that the yellow coating existed before the 1566 Tyndale Bible was rebound in the 18th century (Harry Campbell, "Conservation Treatment Report for Tyndale Bible – New Testament, 1566")



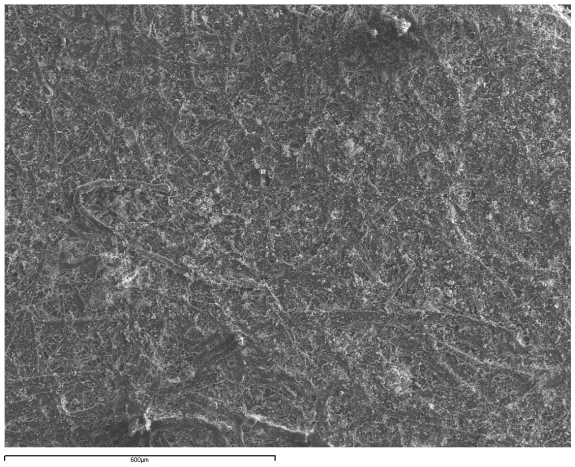
6. The 1566 Tyndale Bible (Harry Campbell, "Conservation Treatment Report for Tyndale Bible – New Testament, 1566")



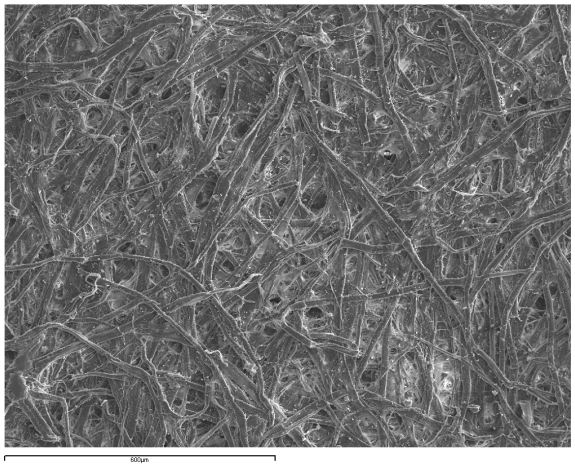
7. Before treatment of the verso of the title page and the first original colored page (Harry Campbell, "Conservation Treatment Report for Tyndale Bible – New Testament, 1566")




8. After treatment of the verso of the title page and the first original colored page (Harry Campbell, "Conservation Treatment Report for Tyndale Bible – New Testament, 1566")



9. Secondary electron image of 1566 Tyndale Bible paper at 100X magnification (Olesik and Bhattiprolu, "Analysis of Paper from the Bible," pg.1.)



10. Secondary electron image of the reference paper at 100X magnification (Olesik and Bhattiprolu, "Analysis of Paper from the Bible," pg.1.)

**Endnotes**

[1] Henry R. Plomer, *A Short History of English Printing* (London: Kegan Paul, Trench, Trübner and Company, Limited, 1900), 112.
[2] F.F. Bruce, *History of the Bible in English* (New York: Oxford University Press, 1978), 1.
[3] Bruce, *History of the Bible in English*, 5.
[4] Bruce, *History of the Bible in English*, 9.
[5] Bruce, *History of the Bible in English*, 13.
[6] Bruce, *History of the Bible in English*, 15.
[7] Bruce, *History of the Bible in English*, 18.
[8] Bruce, *History of the Bible in English*, 24-25.
[9] David Daniell, *William Tyndale: A Biography* (New Haven: Yale University Press, 1994), 1.
[10] Daniell, *William Tyndale: A Biography*, 9.
[11] Daniell, *William Tyndale: A Biography*, 22.
[12] Daniell, *William Tyndale: A Biography*, 49.
[13] Daniell, *William Tyndale: A Biography*, 55-56.
[14] Daniell, *William Tyndale: A Biography*, 59.
[15] Daniell, *William Tyndale: A Biography*, 54.
[16] Daniell, *William Tyndale: A Biography*, 86 & 94.
[17] Daniell, *William Tyndale: A Biography*, 101.
[18] Daniell, *William Tyndale: A Biography*, 102.
[19] Daniell, *William Tyndale: A Biography*, 108.
[20] Daniell, *William Tyndale: A Biography*, 109 & 134.
[21] Brian Moynahan, *God's Bestseller* (New York: St. Martin's Press, 2002), 72-73.
[22] Moynahan, *God's Bestseller*, 79.
[23] Moynahan, *God's Bestseller, 91-92.*
[24] Moynahan, *God's Bestseller, 93-95.*
[25] Moynahan, *God's Bestseller, 98.*
[26] Moynahan, *God's Bestseller, 104.*
[27] Moynahan, *God's Bestseller, 109.*
[28] Moynahan, *God's Bestseller, 122-125.*
[29] Moynahan, *God's Bestseller, 127.*
[30] Moynahan, *God's Bestseller, 129-130.*
[31] Moynahan, *God's Bestseller, 134-135.*
[32] Moynahan, *God's Bestseller, 144.*
[33] Moynahan, *God's Bestseller, 150-152.*
[34] Moynahan, *God's Bestseller, 158.*
[35] Moynahan, *God's Bestseller, 161-162.*
[36] Moynahan, *God's Bestseller, 177.*
[37] Moynahan, *God's Bestseller, 184.*
[38] Moynahan, *God's Bestseller, 186-187.*
[39] Moynahan, *God's Bestseller, 191.*
[40] Moynahan, *God's Bestseller, 205.*
[41] Moynahan, *God's Bestseller, 209-210.*

[42] Brian Moynahan, *God's Bestseller* (New York: St. Martin's Press, 2002), 221.
[43] Moynahan, *God's Bestseller,* 226.
[44] Moynahan, *God's Bestseller, 230.*
[45] Moynahan, *God's Bestseller, 234.*
[46] Moynahan, *God's Bestseller, 237.*
[47] Moynahan, *God's Bestseller, 268.*
[48] Moynahan, *God's Bestseller, 273-274.*
[49] Moynahan, *God's Bestseller, 286.*
[50] Moynahan, *God's Bestseller, 295.*
[51] Moynahan, *God's Bestseller, 298.*
[52] Moynahan, *God's Bestseller, 315.*
[53] Moynahan, *God's Bestseller, 320-321.*
[54] Moynahan, *God's Bestseller, 322-323.*
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[56] Moynahan, *God's Bestseller, 330-333.*
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